Amendments to the Specification:

A Substitute Specification is submitted herewith. A marked-up copy of the original specification showing the amendments contained in the Substitute Specification is also submitted herewith. It is submitted that the Substitute Specification does not introduce new matter.

SUBSTITUTE SPECIFICATION

A TECHNIQUE FOR SETTING UP CALLS

IN MOBILE NETWORK

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001]   This application is a continuation-in-part of

U.S. Application Serial No. 09/546,209, filed in the U.S.

Patent and Trademark Office on April 10, 2000, now

abandoned.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002]   The present invention relates to mobile networks

and, more particularly, the present invention relates to a

technique for setting up multimedia calls in mobile

networks using an IP (Internet Protocol) transport

mechanism.

Description of the Related Art

[0003]   In general, packet switched wireless networks

provide communications for mobile terminals with no

physical connection required for network access. The

General Packet Radio Service (GPRS) in the Global System

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for Mobile Communications (GSM) and the Universal Mobile Terrestrial System (UMTS) have both been developed to provide wireless communications networks with a packet switched side, as well as a circuit switched side.

[0004]   The specification for a UMTS network with further improvements has been released by the 3rd General Partnership Project. The UMTS specification provides that a network subscriber can have one or more packet data protocol (PDP) addresses. Each PDP address is described by one or more PDP contexts in the Mobile Station (MS), the Service GPRS Service Node (SGSN), and the Gateway GPRS Service Node (GGSN). A GGSN is a gateway to an external network. Each PDP context may have routing and mapping information for directing the transfer of data to and from its associated PDP address and a traffic flow template (TFT) for reviewing the transferred data.

[0005]   Each PDP context can be selectively and independently activated, modified, and deactivated. The activation state of a PDP context indicates whether data transfer is enabled for a corresponding PDP address and TFT. If all PDP contexts associated with the same PDP address are inactive or deactivated, all data transfer for that PDP address is disabled. All PDP contexts of a subscriber are associated with the same Mobility Management

(MM) context for the International Mobile Subscriber

Identity (IMSI) of that subscriber. Setting up a PDP

context means setting up a communications channel.

[0006] An example of the PDP context activation

procedure is shown in FIG. 2. The activate PDP context

request message sent in step 1 includes a number of

parameters. The parameters include a PDP address and an

Access Point Name (APN). The PDP address is used to

indicate whether a static PDP or dynamic PDP address is

required. The APN is a logical name referring to the

Gateway GPSR Support Node (GGSN) to be used. In step 3,

the SGSN sends a Radio Access Bearer (RAB) setup message to

the UMTS Terrestrial Radio Access Network (UTRAN). In step

4, the SGSN sends a Create PDP Context Request message to

the affected GGSN. The GGSN decides whether to accept or

reject the request. If it accepts the request, it modifies

its PDP context table and returns a Create PDP Context

Response message. The SGSN then sends an activate PDP

Context Accept message to the MS in step 5.

[0007] In spite of the numerous details provided in the

aforementioned Protocol, many features associated with IP

mobile networks have not been addressed. Specifically, the

techniques for expeditiously setting up multimedia calls in

IP-based mobile networks have yet to be incorporated in the

aforementioned Protocol. It is these details to which the present invention is directed.

SUMMARY OF THE INVENTION

[0008]   The signaling that is exchanged by the application layers in the MS (mobile station) and in the network is arranged in accordance with the procedure/messages that need to be performed by the transport levels in the MS and in the network in order to set up multimedia calls.

[0009]   When the application level in the MS sends a set up message to set up a multimedia call, before sending such a message over the radio interface, the MS performs the appropriate procedures, depending on the type of access adopted, to set up the appropriate bearers over the radio interface and in the network to satisfy the call requirements specified by the application level in the set up message.

[0010]   The present invention applies to both the case of mobile originated calls and mobile terminated calls, the called MS performing the above noted transport level procedures after having received a set up message and before sending a confirmation/call acceptance message back to the calling party.

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[0011]   In accordance with the technique of the present invention, the allocation of radio resources for PDP (packet data protocol) contexts that will be used to carry the media of a multimedia IP call is delayed so that no radio resources are allocated to the PDP contexts activated before the call control signaling is exchanged. The radio resources are allocated only when the call signaling has been completed and the called party has accepted the call and indicated the call characteristics that it can support.

[0012]   Furthermore, in accordance with the technique of the present invention, an indication is forwarded from the SGSN (Serving GPRS (General Packet Radio Service) Support Node) to the GGSN (Gateway GPRS Support Node) advising that no packets are to be sent on the PDP context because there are no radio resources for the PDP context.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]   The foregoing and a better understanding of the present invention will become apparent from the following detailed description of example embodiments and the claims when reading in connection with the accompanying drawings, all forming a part of the disclosure of this invention. While the foregoing and following written and illustrated disclosure focuses on disclosing example embodiments of the

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invention, it should be clearly understood that the same is
by way of illustration and example only and the invention
is not limited thereto. The spirit and scope of the
present invention are limited only by the terms of the
appended claims.

[0014]   Fig. 1 is a generalized block diagram of the
prior art architecture of a packet switched wireless
communication network in which the example embodiments of
the invention may be practiced.

[0015]   Fig. 2 is a generalized signaling flow diagram
illustrating the prior art PDP context activation
procedures.

[0016]   Fig. 3 is a generalized signal flow diagram
illustrating a call set up arrangement.

[0017]   Fig. 4 is a generalized signal flow diagram
illustrating a delayed resource deployment arrangement in
accordance with a technique of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0018]   Before beginning a detailed description of the
subject invention, mention of the following is in order,
when appropriate, like reference numerals and characters
may be used to designate identical, corresponding, or
similar components in differing drawing figures.

Furthermore, in the detailed description to follow, example sizes/models/values/ranges may be given, although the present invention is not limited thereto.

[0019]   An example of a network architecture supporting these specifications is the wireless communications network shown in the block diagram of FIG. 1. The various elements of the network and their functions are described in the 3rd Generation Partnership Project (3GPP); Technical Specification Group Services and System Aspects; Architecture Principles for Release 2000 (3G TR 23.821 version 1.0.0), published by the 3rd Generation Partnership Project and which is hereby incorporated herein by reference in its entirety. The elements and their functions may be described in earlier or later versions of the specifications or maybe those of any other known packet switched wireless communications network. The description of network elements and their functions incorporated by reference herein are merely a non-limiting example of packet switched wireless communication networks.

[0020]   Several elements of the example network illustrated in FIG. 1 are particularly relevant to this invention. The Mobile Terminal (MT), commonly referred to as a cell phone or a mobile phone, is only one possible part of User Equipment (UE). Typically, Terminal Equipment

(TE), used together with a Mobile Terminal (MT),

constitutes User Equipment (UE) or a Mobile Station (MS).

Any UE may be utilized in conjunction with this invention

so that it operates or can be programmed to operate in the

manner described below. The UMTS Terrestrial Radio Access

Network (UTRAN) and the Base Station System (BSS) in GPRS

manage and control the radio access between the network and

a number of Mts.

[0021]   The Serving GPRS Support Node (SGSN) is the node

that serves the MT. At PDP Context Activation, the SGSN

establishes a PDP context used for routing purposes. The

Gateway GPRS Support Node (GGSN) is the node accessed by

the packet data network due to evaluation of the PDP

address. It contains routing information for attached GPRS

users. The routing information is used to tunnel Protocol

Data Units (PDUs) to the SGSN. The SGSN and GGSN

functionalities may reside in different physical nodes or

may be combined in the same physical node, for example, an

Internet GPRS Support Node (IGSN).

[0022]   Fig. 3 illustrates the call set-up arrangement.

The IP-based mobile network architecture includes an

application level and a transport level. The transport

level protocols and mechanisms are usually optimized for

the specific type of access whereas the application level

is normally generic, that is independent of the type of access.

[0023]   In IP-based mobile networks, the application level in the MS sets up a call by signaling to the peer entity and exchanging messages of a call control protocol over an IP connection provided by the transport levels. In setting up a call for the application level, the underlying transport level has to set up the transport bearers over the radio interface and in the network. For an IP-based mobile network, setting up of transport bearers means allocating radio resources and network resources. Since the call control signaling is transparently exchanged over an IP connection provided by the transport level, the transport levels are not aware that a call is being set up.

[0024]   As illustrated in Fig. 3, the technique begins at the application level at step 1 in which a set up indication is forwarded from the application level to the mobile terminal MT or MS level, the set up indication including the requested logical channels and characteristics.

[0025]   At step 2, an Activate PDP Context Request is transmitted to the SGSN from the MT. In response thereto, in step 3, the SGSN transmits a Create PDP Context Request to the GGSN. In response to the Create PDP Context Request

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from the SGSN, in step 4, a Create PDP Context Response is transmitted from the GGSN to the SGSN. In turn, in response to the Create PDP Context Response from the GGSN to the SGSN, in step 5, an Activate PDP Context Accept is transmitted to the MT or MS by the SGSN.

[0026]   The above-noted procedures in steps 2-5 are repeated as many times as needed depending on the number of PDP contexts needed.

[0027]   Upon the completion of the last procedure in step 5, the MT transmits a Setup indication, including requested logical channels and characteristics, to the CSCF (Call State Control Function) in step 6. The CSCF, in turn, transmits the Setup indication, including requested logical channels and characteristics, to the REP (Remote End Point) in step 7. The REP then transmits a Connect indication, including accepted logical channels and characteristics, back to the CSCF in step 8. The CSCF then transmits the Connect indication, including accepted logical channels and characteristics, to the MT in step 9.

[0028]   In step 10, the MT transmits a Modify PDP Context Request, including a Called Party TA (Transport Address), to the SGSN. In step 11, the SGSN performs an RAB Modification. In step 12, in response to the RAB Modification, the SGSN transmits an Update PDP Context

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Request, including the Called Party TA, to the GGSN. In

response to the Updated PDP Context Request, the GGSN, in

step 13, transmits an Update PDP Context Response to the

SGSN. In response thereto, the SGSN, in step 14, transmits

a Modify PDP Context Accept to the MT. The MT, in turn,

transmits a Connect indication including accepted logical

channels and characteristics to the application level in

step 15. Lastly, in step 16, the application level

transmits an ACK (acknowledgement) indication to the REP

via the CSCF.

[0029]   The technique noted above, is based on a very

simple mechanism and applies to different types of

transport levels. In addition, the technique does not

require any interface on the network side for the

interaction between the application level and the transport

level.

[0030]   Unfortunately, in the technique illustrated in

Fig. 3, resources for PDP contexts that will be used to

carry the media of a multimedia call are immediately

allocated, thereby resulting in wasted radio resources upon

the called party being unable to accept the call.

[0031]   Fig. 4 illustrates an example of the technique in

accordance with the present invention. As illustrated

therein, the allocation of resources for PDP contexts that

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will be used to carry the media of a multimedia IP call is delayed so that no radio resources are allocated to the PDP contexts before the call control signaling is exchanged. Rather, the radio resources are allocated only when the call signaling has been completed and the called party has accepted the call and indicated the call characteristics that it can support.

[0032]   As illustrated in Fig. 4, in step 1, the application level transmits a set up indication, including requested logical channels and characteristics, to the mobile terminal MT level, that is, the MS.

[0033]   In step 2, an Activate PDP Context Request including a Delayed Flag is transmitted from the mobile terminal MT level, that is, the MS, to the SGSN. The Delayed Flag is a new parameter which is added to the Activate PDP Context Request so as to inform the SGSN that no radio resources have to be allocated. This ensures that the radio resources will be allocated only after the PDP context has been modified. Note that the Delayed Flag may also be transmitted to the GGSN as well as to the SGSN. While this is optional, it is preferable in that in some arrangements, it is advantageous for the GGSN to be informed that no radio resources have been allocated. When receiving the Delayed Flag, the GGSN may restrict traffic

on the PDP context. The GGSN may store a flag indicating that no traffic is allowed to be carried on the PDP context or may set the TFT of the PDP context so that no traffic can be carried on the PDP context.

[0034]   In step 3, the SGSN transmits the Delayed Flag in a RAB Establishment Request to a RNC in a second network which is radio access network which may be a IP multimedia subsystem (IMS) network. When receiving the Delayed Flag, the RNC checks the availability of radio access network resources. In step 4, the RNC sends RAB Establishment Response to the SGSN to indicate the result of the radio access network resource check.

[0035]   In step 5, the SGSN transmits a Create PDP Context Request to the GGSN which in turn transmits a Create PDP Context Response to the SGSN in step 6. In step 7, the SGSN transmits an Activate PDP Context Accept to the MS. In step 8, the MS forwards a Setup indication including requested logical channels and characteristics to the CSCF which, in turn, transmits a Setup indication including requested logical channels and characteristics to the REP in step 9.

[0036]   In step 10, the REP transmits a Connect indication including accepted logical channels and characteristics to the CSCF. In step 11, a Connect

indication including accepted logical channels and characteristics are transmitted from the CSCF to the MS. In step 12, the MS creates a Modify PDP Context Request including the Called Party Transport Address and transmits it to the SGSN.

[0037] In step 13, the SGSN, together with the MS and an RNC, for example, perform an RAB Modification. In step 14, the SGSN transmits an Update PDP Context Request including the Called Party Transport Address to the GGSN which, in turn, in step 15, transmits an Update PDP Context Response back to the SGSN. In step 16, the SGSN transmits a Modify PDP Context Accept to the MS which in turn forwards an ACK indication to the CSCF in step 17 which in turn transmits it to the REP in step 18.

[0038] In setting up a call for an application, the underlying transport network sets up the transport bearers over the radio interface and in the network. For a wireless network, the setting up of transport bearers means the allocation of radio resources.

[0039] By utilizing the above-noted call setup technique in accordance with the present invention utilizing the delayed flag, radio resources over the wireless interface are not wasted due to unsuccessful call setups, (for example, called party busy, no answer, wrong number, etc.).

Any effort to maximize the usage performance of radio

resources is a must for wireless operators with limited

frequency spectrum availability.

[0040]   Before the call control signaling is exchanged

between the calling party and the called party, the only

information available regarding the radio and network

resources needed for the call are the resources requested

by the calling party. Since the called party may not

accept the call features, (for example, medias and QoS),

proposed by the calling party and rather proposes a subset

of the requested features, allocating radio and network

resources prior to the call signaling being completed leads

to wasted resources and in fact, the radio resources that

have been allocated will be unused during the time between

the call initiation and the call setup completion.

However, by utilizing the delayed flag in accordance with

the technique of the present invention, resources are not

wasted since they are allocated only after the PDP Context

has been modified.

[0041]   Furthermore, until the call setup signaling has

been performed, the calling party does not know the TA

(Transport Address), that is, the IP address plus port

number, or the called party and therefore cannot provide

the complete TFT (Traffic Flow Template) to the SGSN/GGSN.

The technique of the present invention, by modifying the PDP context, avoids this problem.

[0042]   As a modification to the above-noted technique in accordance with the present invention which utilizes the delayed flag, as an additional step, the SGSN, upon receiving the delayed flag, forwards the delayed flag to the GGSN as an indication that no packets should be sent on the PDP Context because there are no radio resources, (that is, no RAB), for the PDP context. In addition, the SGSN may set the charging characteristics of the PDP context as "free of charge". The SGSN indicates the charging characteristics of the PDP Context to the GGSN in the Create PDP Context Request message.

[0043]   It is to be noted that in the description of the invention above, numerous details known to those skilled in the art have been omitted for the sake of brevity. Such details are readily available in numerous publications including the previously cited Protocol. Accordingly, the contents of the previously cited Protocol are incorporated by reference herein.

[0044]   This concludes the description of the example embodiments. Although the present invention has been described with reference to a number of illustrative embodiments, it should be understood that numerous other

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modifications and embodiments can be devised by those skilled the art which will fall within the spirit and scope of the principles of this invention. More particularly, reasonable variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the foregoing disclosure, the drawings, and the appended claims without departing from the spirit of the invention. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled the art.